PROCEEDINGS

53. IWK

Internationales Wissenschaftliches Kolloquium
International Scientific Colloquium

Faculty of
Mechanical Engineering

PROSPECTS IN MECHANICAL ENGINEERING

8 - 12 September 2008

www.tu-ilmenau.de

TECHNISCHE UNIVERSITÄT
ILMENAU

Home / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=17534

Published by
Impressum

Publisher Herausgeber	Der Rektor der Technischen Universität Ilmenau Univ.-Prof. Dr. rer. nat. habil. Dr. h. c. Prof. h. c. Peter Scharff
Editor Redaktion	Referat Marketing und Studentische Angelegenheiten Andrea Schneider
	Fakultät für Maschinenbau Univ.-Prof. Dr.-Ing. habil. Peter Kurz, Univ.-Prof. Dr.-Ing. habil. Rainer Grünwald, Univ.-Prof. Dr.-Ing. habil. Prof. h. c. Dr. h. c. mult. Gerd Jäger, Dr.-Ing Beate Schlütter, Dipl.-Ing. Silke Stauche
Editorial Deadline Redaktionsschluss	17. August 2008
Publishing House Verlag	Verlag ISLE, Betriebsstätte des ISLE e.V. Werner-von-Siemens-Str. 16, 98693 Ilmenau

CD-ROM-Version:

Implementation Realisierung	Technische Universität Ilmenau Christian Weigel, Helge Drumm
Production Herstellung	CDA Datenträger Albrechts GmbH, 98529 Suhl/Albrechts

ISBN: 978-3-938843-40-6 (CD-ROM-Version)

Online-Version:

Implementation Realisierung	Universitätsbibliothek Ilmenau ilmedia Postfach 10 05 65 98684 Ilmenau

Home / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=17534

53rd Internationales Wissenschaftliches Kolloquium
Technische Universität Ilmenau
08 – 12 September 2008

S. Griebel / V. Böhm / L. Zentner

Actuator development based on snail tentacles

ABSTRACT

The observation of the snail (helix pomatia L.) provides the biological inspiration for a new compliant mechanism realized with silicone. After identifying the advantages an analytic model was developed. The influence of the design parameter on the motion behavior of the center of the structure under internal pressure was investigated with the finite element method (FEM). The motion behavior of the first prototype shows similar quantitative and qualitative characteristics compared to the simulated model.

INTRODUCTION

The snail tentacle creates an upstroke movement by increasing the pressure in the snail body (Fig.1). This principle, which enables remarkable upstroke-diameter ratios, can be used for coherent technical structures (consisting of one part). The integration of the drive in the structure or the material, respectively, as well as the protection of the possibly integrated sensory in the retracted state promise high potential for technical applications such as sensor placements.

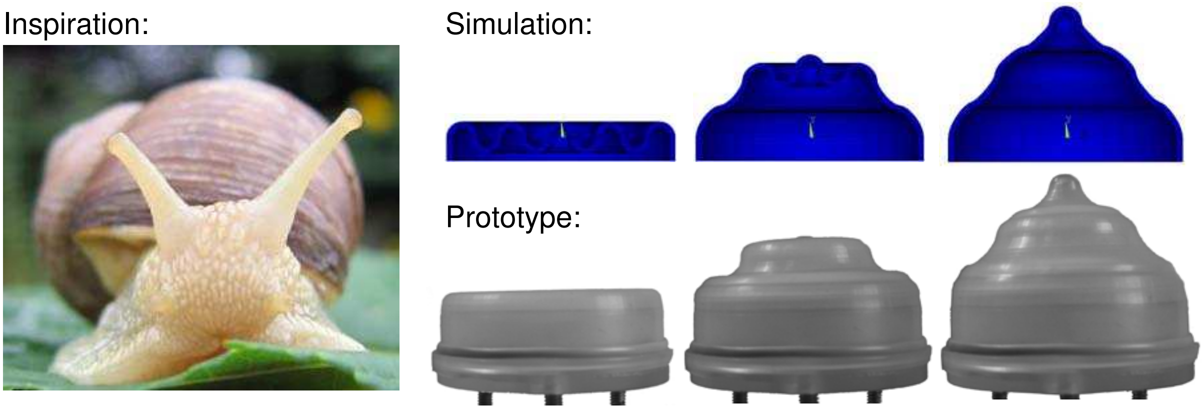

Fig. 1: Snail with tentacles (l.), finite element model and prototype under increasing internal pressure load (r.)

MATERIALS AND METHODS

First, an analytical model with geometrical parameters was obtained. The finite element method was applied to investigate the displacement of the center of the structure in consideration of the internal pressure load for different geometric ratios between radius and thickness. The rubber-like silicone material was implemented into the model using the 3rd order constitutive law of Yeoh based on data from experimental uniaxial tension.

RESULTS AND DISCUSSION

Fig. 2 (l.) shows the displacement of the center of the structure with constant radius as a function of internal pressure load by varying thickness. Depending on the chosen geometric ratio the compliant structure is able to create continuous movement of the center of the structure or fast snap through characteristics with monostable or bistable behavior. The comparison of the real behavior of the first prototype with the simulated predicted behavior shows a similar qualitative and quantitative characteristic (Fig. 2 (r.)). In simulations, the mechanism proved scale invariant and can be miniaturized if the geometrical ratios are kept constant.

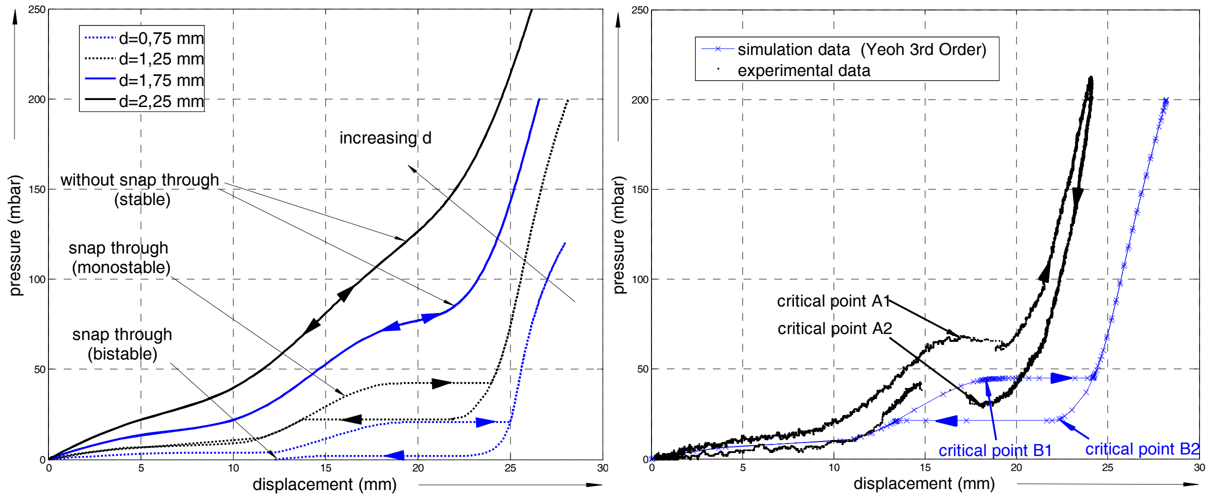

Fig. 2: (l.) Different characteristic curves of the compliant structure by varying thickness; (r.) characteristic curve of one prototype according to the simulated model by equal geometrical ratio (r.)

CONCLUSION

The biological principle (upstroke movement by increasing the pressure) was put into practice for the preparation of technical applications. The compliant mechanism has a sustainable capability for sensor positioning. The compliance and biocompatibility of the used material enable further applications in biomedical engineering.

Authors:
Dipl.-Ing. Stefan Griebel[1]
Dr.-Ing. Valter Böhm[2]
Priv.-Doz. Dr.-Ing. habil. Lena Zentner[1]
TU Ilmenau, Fakultät Maschinenbau, FG Getriebetechnik[1], FG Technische Mechanik[2]

Technische Universität Ilmenau
P.O.B. 10 05 65
D-98684 Ilmenau
Phone: +49 3677 69 1811
Fax: +49 3677 69 1823
E-mail: stefan.griebel@tu-ilmenau.de